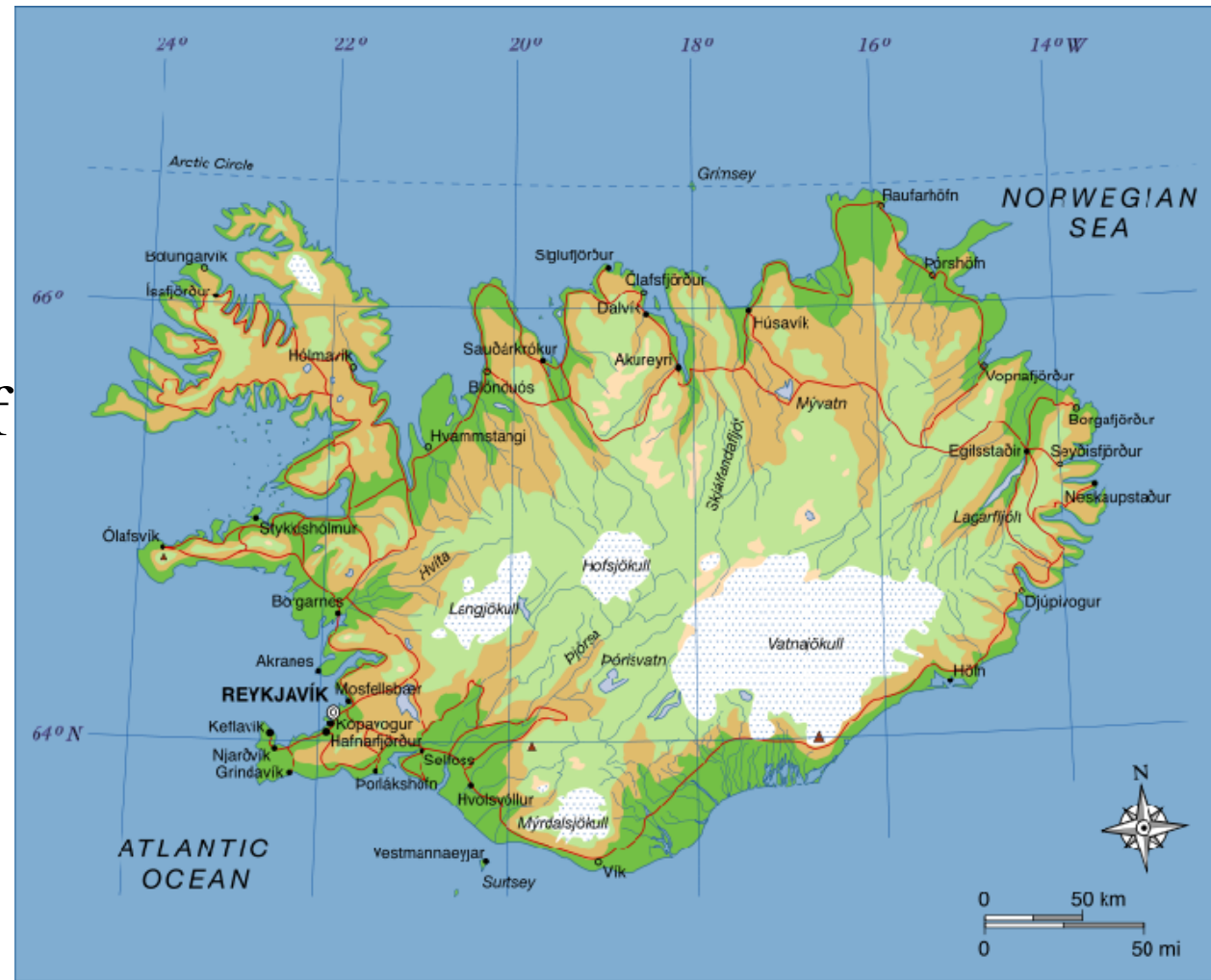


Iceland

- 300,000 people in the middle of the far North Atlantic



Iceland is Resource Poor



Iceland is Wealthy

- 1945: poorest country in Europe
- 2005: second richest country in Europe



How Did They Do That?

- Capital accumulation:
 - National pension plan from 1945, required contribution from employees & employers
- Energy Independence:
 - Energy independent for light, heat, & power
 - Import oil only for transportation
 - No other energy imports
 - 100% publicly owned power (recent private investment)

One Hundred Years

- Hot water heating started in about 1905:
 - Heat schools, city hall, other buildings from surface water.
 - Development of hot water wells and district heating.
- Energy Independence:
 - Became official national policy after 1973 oil embargo
 - Government funded research into geothermal development
 - Government investment in hydro

Power Sources

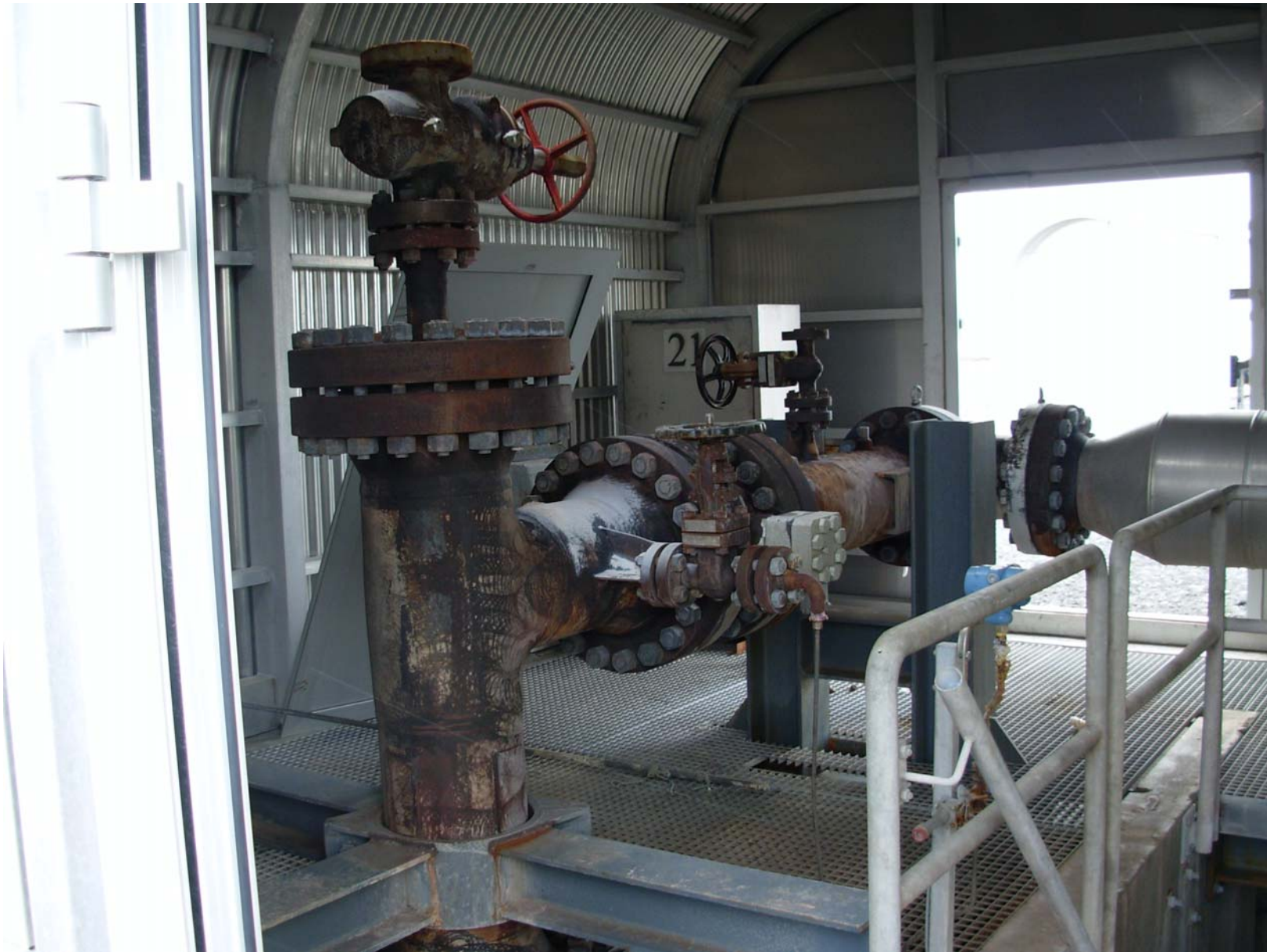
- Space heating: 90% geothermal, through municipally owned district heating systems. (100 years of development)
- Electricity:
 - 75% Hydro
 - 25% Geothermal
- Geothermal electricity has ramped up only in last 15 years, after massive R&D.

Svartsengi Geothermal Power Plant

- 75 MWe
- 475 liters/second hot water



Geothermal Well Head



Svartsengi Power House



Drilling rig at Reykjanes geothermal plant

- Oil drilling rigs & directional techniques used to find the right spot in the reservoir.
- Drilling is the major capital cost.
- 5 to 20 working boreholes per plant.
- Rough power: 5MWe per bore hole



Blue Lagoon: an environmental mistake



Hellisheidi Geothermal Power Plant

Reykjavik Municipal Power Company

300 MWe, 400 MWt





Lessons for Montana

- Do your homework (i.e., research)
 - Must characterize the geothermal resource, by depth, heat, and size.
 - This is a geology project, techniques are well known.
- Start with Space Heating
 - Low tech, easy to exploit
 - Immediate opportunity at Montana Tech